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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 08/994,038
Filing Date: December 18, 1997
Appellant(s): YAMAZAKI ET AL.

MAILED
APR 21 2006
GROUP 2800

John F. Hayden
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed March 20, 2006 appealing from the Office action mailed September 30, 2004.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

No evidence is relied upon by the examiner in the rejection of the claims under appeal.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 1 03

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 2, 6, 12, 14, 16, 18, 19,12, 22, 23, 24, 25 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Inoue et al., U.S. Patent 5,873,003 in view of Okada et al., U.S. Patent 5,582,640.

3. Pertaining to claim 2, Inoue discloses a semiconductor device substantially as claimed. See FIGS. 1-50, where Inoue teaches a semiconductor device comprising:

a plurality of photodiodes 403 (as seen in FIG. 22) being formed in a matrix on an insulating surface 1609;

a plurality of vertical charge coupled devices on the insulating surface, said vertical charge coupled devices being connected with the plurality of photodiodes; (see FIG. 16);
at least a horizontal charge coupled device on the insulating surface, said horizontal charge coupled device being connected with the vertical charge coupled devices, wherein at least one of the vertical and horizontal charge coupled devices comprises a crystalline semiconductor film having a plurality of crystals extending in a crystal growth direction,

wherein a crystal structure of the crystalline semiconductor film 1753 in the crystal growth direction is continuous so that a charge moving is not restricted by a grain boundary.
However, Inoue fails to explicitly teach wherein at least one of the vertical and horizontal charge coupled devices that has the crystalline semiconductor film is arranged such that a charge transfer direction of the at least one of the vertical and horizontal charge coupled devices is coincident with the crystal growth direction. Okada teaches that the crystalline semiconductor film is arranged such that a charge transfer direction of the at least one of the vertical and horizontal charge coupled devices is coincident with the crystal growth direction. See FIGS. 1-158(h) where Okada teaches horizontally crystallization, also see FIG. 50(d) where Okada teaches the growth direction of the silicon grain. In view of Okada, it would have been obvious

to the crystalline semiconductor film is arranged such that a charge transfer direction of the at least one of the vertical and horizontal charge coupled devices is coincident with the crystal growth direction, because the mobility between the presence and absence of the grain boundary becomes more remarkable (column 62, lines 34-56).

4. Pertaining to claim 23, Inoue discloses further an active matrix display device. Okada teaches a semiconductor device to be an active matrix display device. In view of Okada, it would have been obvious to one of ordinary skill in the art to incorporate the active matrix display device of Okada into the Inoue device because a high quality picture is reproduced (column 1, lines 25-27).

5. Pertaining to claim 11, Inoue discloses wherein the crystalline semiconductor film 2 is formed over a quartz substrate, and wherein an incident light is made from a side of the quartz substrate (see claim 12 of Inoue).

6. Pertaining to claim 12, Inoue discloses wherein the charge transfer direction includes a plurality of directions (polycrystalline film option).

7. Pertaining to claim 14, Inoue discloses wherein the semiconductor film is a silicon film. Pertaining to claims 17 and 20, Inoue discloses wherein the crystalline semiconductor film is formed over a quartz substrate.

8. Pertaining to claims 16 and 19, Inoue discloses a semiconductor device comprising: a crystalline semiconductor film being formed on an insulating surface,

said crystalline semiconductor film having a plurality of crystals extending in a crystal growth direction (polycrystalline) which is parallel to the insulating surface;

an insulating film on the crystalline semiconductor film;

a plurality of electrodes being formed on the insulating film, each of said plurality of electrodes being located within a predetermined distance so that a plurality of MOS capacitors 11 formed between the plurality of electrodes and the crystalline semiconductor film with the insulating film therebetween,

wherein a charge transferred from one of the MOS capacitors to another of the MOS capacitors in a charge transfer direction,

wherein a crystal structure of the crystalline semiconductor film is continuous so that the crystal structure is regarded as single crystal for the charge,

wherein the charge transfer direction is coincident with said crystal growth direction.

9. Pertaining to claim 18, Inoue discloses wherein the semiconductor device consist of an image sensor.

10. Pertaining to claims 21 and 22, Inoue discloses an image sensor (CCD), which consist of a photodiode.

11. Pertaining to claims 25 and 26, Inoue discloses a semiconductor device comprising:

a photoelectric conversion (silicon interacting with light) formed over an insulating surface;

a charge coupled device electrically connected to the photoelectric conversion device and formed over the insulating surface;

said charge coupled device including:

a crystalline semiconductor film formed on the insulating surface, said crystalline semiconductor film having a plurality of crystals (polycrystalline silicon as taught by Inoue) extending in a crystal growth direction which is parallel to the insulating surface;

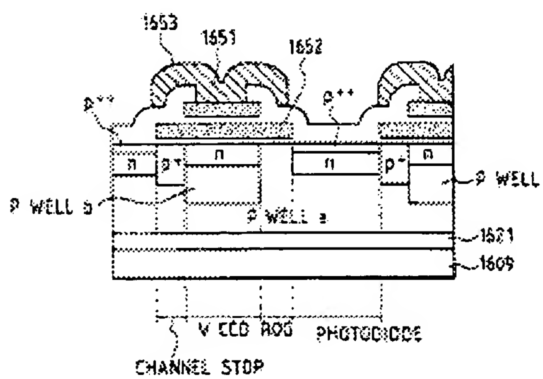
an insulating film on the crystalline semiconductor film (MOSFET section);

a plurality of electrodes (having a predetermined distance, which becomes an active matrix display) formed on the insulating film (Inoue teaches forming an array, column 6, lines 8-11) so that a plurality of MOS capacitors are formed between the plurality of electrodes and the crystalline semiconductor film with the insulating film therebetween,

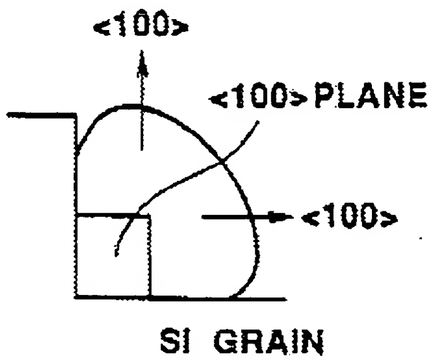
wherein a charge is transferred from one of the MOS capacitors to another of the MOS capacitors in a charge transfer direction,

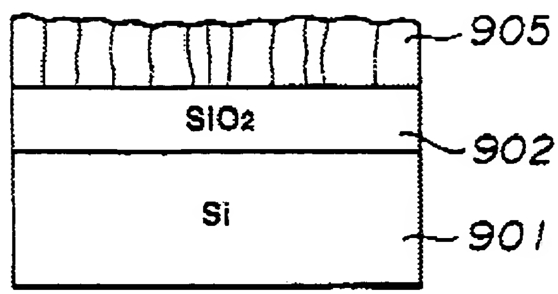
wherein the charge transfer direction is coincident with the crystal growth direction.

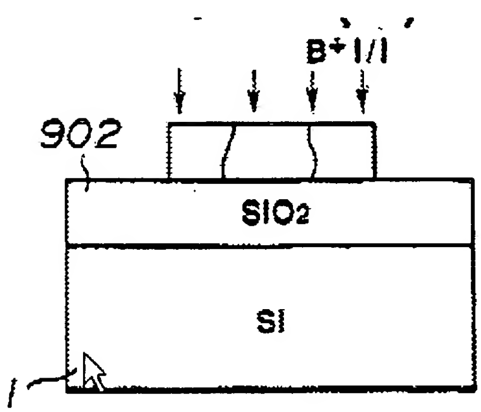
Inoue teaches a plurality of photodiodes, see FIG. 50 and that the thin film transistors (i.e., MOSFETS can be single crystal (see column 3, line 48)

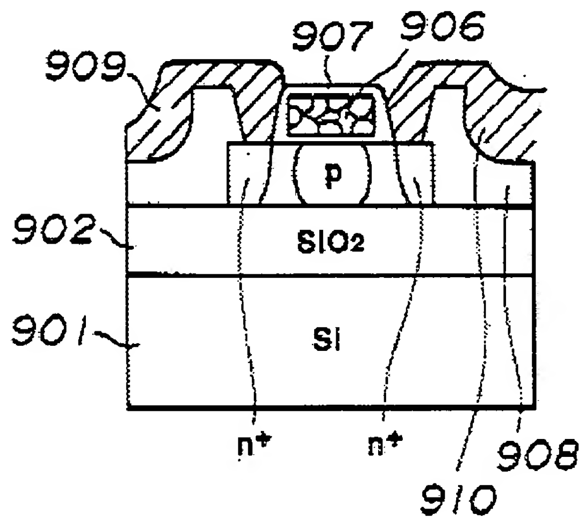


Okada teaches the structure of a typical MOFSET which is used as a photodiode, see FIGS. 84(a)-84(g) discloses a single crystal silicon wherein the crystal structure of the crystalline semiconductor film 905 in the crystal growth direction is continuous so that a charge moving is not restricted by a grain boundary.









(10) Response to Argument

Applicants contend that the combined teachings fail to disclose at least one vertical and one horizontal charge coupled device having a plurality of crystals extending in a crystal growth direction.

Although the primary reference does not explicitly teach the crystal growth direction coinciding with the charge transfer direction, the primary reference does teach that the material can be polycrystalline silicon or single crystalline silicon are semiconductors and therefore Applicants argument is moot. All polycrystalline semiconductor materials and single crystal semiconductor

materials deposited on a substrate will grow in a vertical direction (i.e. thickness) and a horizontal direction (width) and all materials have at least two (2) dimensions and thickness and width being at least two of three (3) dimensions. Since the primary reference teaches polycrystalline silicon and single crystalline silicon, charge traveling along the crystal is only limited by the grain boundary. Applicants have failed to disclose why the charge moving (i.e., electrons) along the grain boundary of the crystal is different from the prior art. One of the major reasons why there is charge traveling in the semiconductor material is because impurities such as phosphorus, arsenic or boron is introduced into the semiconductor material. Applicants disclosure is silent as to why the material as claimed is different from the prior art material. All materials of the same substance and same structure will have the same properties and the Applicants have failed to distinguish any differences.

Applicants contend that the claims are allowable because the term "a crystal structure of the crystalline semiconductor film in the crystal growth direction is continuous so that a charge moving is not restricted by a grain boundary" is a unique feature.
In response to Applicants contention that the term "a crystal structure of the crystalline semiconductor film in the crystal growth direction is continuous so that a charge moving is not restricted by a grain boundary" is a unique feature, please note that the claimed limitations are obvious features of semiconductor materials that have the same crystal structure, and therefore Applicants argument is moot. It is well known that charge traveling through or along amorphous material has reduced mobility since the path or distance of the charge traveling is increased (i.e., various paths to move from point A to point B), mobility has a relationship with resistance.

Polycrystalline semiconductor material has increased mobility as compared to amorphous semiconductor material and single crystal semiconductor material has increased mobility as compared to polycrystalline semiconductor material.

Applicants contend that the claims are allowable because the secondary reference is silent as to the term "CCD" (i.e., charge coupled device).

In response to Applicants contention that the secondary reference fails to disclose the term "CCD", the secondary reference was relied upon only for the structure of the crystalline

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Conferees:

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